

# CHAPTER 23

## The Red Eye

### KEY TEACHING POINTS

- In patients with red eye, the findings of anisocoria or painful pupillary constriction increase the probability of serious eye disease.
- The presence of significant eye pain or visual blurring in the patient with red eye should prompt referral to a specialist.
- Bacterial conjunctivitis is more likely than viral or allergic conjunctivitis if there is bilateral matting of the eyes, conjunctival redness obscuring tarsal vessels, or purulent discharge.

### I. INTRODUCTION

The term **red eye** refers to several acute inflammatory disorders of the eye, all of which produce prominent ocular erythema. For clinicians evaluating patients with the red eye, the most important decision is to distinguish serious disorders (e.g., iritis, keratitis, corneal abrasion, or scleritis) from more benign disorders of the conjunctiva (e.g., conjunctivitis, episcleritis, or subconjunctival hemorrhage). All patients with serious disorders require urgent referral to an eye specialist. In patients with suspected conjunctivitis, clinicians also want to distinguish bacterial conjunctivitis from nonbacterial (viral, allergic) conjunctivitis because only bacterial conjunctivitis benefits from administration of topical antimicrobial eye drops.<sup>1</sup> This chapter focuses on those bedside findings addressing these two questions.

Descriptions of the red eye are as old as ophthalmologic records, figuring prominently in descriptions from ancient Egypt and classical Greece and Rome.<sup>2</sup> Many patients in these ancient descriptions likely suffered from trachoma or other contagious diseases of the eye.<sup>3</sup> The French ophthalmologist Charles Saint Yves (1667–1736) is credited with the first clear description of iritis, including its characteristic redness, photophobia, pain, and decreased pupillary diameter.<sup>2</sup>

### II. THE FINDINGS

#### A. DISTINGUISHING SERIOUS FROM BENIGN DISEASE

The traditional signs of serious causes of the red eye are significant eye pain, visual blurring, photophobia, and abnormalities of the pupil.

#### I. VISUAL ACUITY

Benign causes of the red eye do not affect visual acuity, except for the temporary effects of purulent exudate in bacterial conjunctivitis, a blurriness that resolves when secretions are wiped away. In contrast, corneal disease and iritis may cause

significant blurriness of vision, either from opacification of the cornea (corneal infiltrates) or from inflammatory exudate and cells in the anterior chamber (iritis).

## 2. PUPILLARY ABNORMALITIES

In benign disease the pupils are normal. However, serious causes of the red eye may produce *anisocoria* (i.e., unequal pupils; see [Chapter 21](#)). Usually the smaller pupil is in the inflamed eye (i.e., relative *miosis*), either from inflammatory congestion of the iris itself, associated ciliary muscle spasm, or both. Rarely the pupil of the inflamed eye is larger than that of the contralateral pupil (relative *mydriasis*), a finding of acute angle-closure glaucoma, from ischemia and infarction of the iris tissue itself (i.e., the pupillary constrictor muscle).

## 3. PUPIL CONSTRICTION TESTS

In serious eye disorders, pupillary constriction may be painful, which explains why many affected patients experience *photophobia* (i.e., pain during exposure to light). Painful pupillary constriction is the basis for three different pupillary constriction tests. These tests differ in how the pupillary constriction is produced, but in all tests the positive response is pain in the *affected* red eye.

### A. DIRECT PHOTOPHOBIA TEST

The clinician shines a penlight into the affected eye (see the section on the Normal Light Reflex in [Chapter 21](#)).

### B. INDIRECT (CONSENSUAL) PHOTOPHOBIA TEST

The clinician shines a penlight into the *contralateral* (i.e., uninflamed) eye (see the section on the Normal Light Reflex in [Chapter 21](#)).

### C. FINGER-TO-NOSE CONVERGENCE TEST

The patient focuses on his or her outstretched finger and slowly moves the finger toward his or her nose (see the section on the Near Synkinesis Reaction in [Chapter 21](#)).

## B. DISTINGUISHING BACTERIAL CONJUNCTIVITIS FROM NONBACTERIAL CAUSES

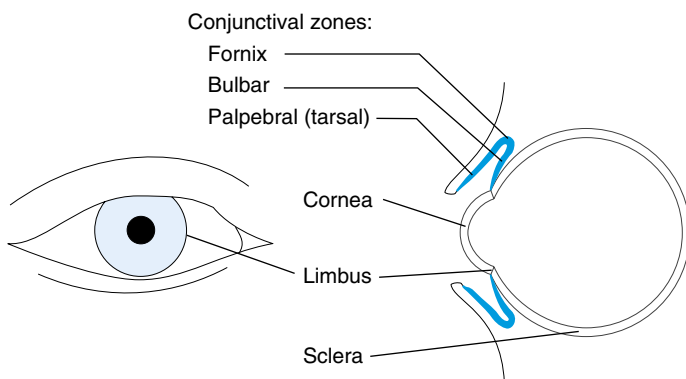
According to traditional teachings, bacterial conjunctivitis is more likely if disease onset is during the winter months or if there is a purulent exudate,<sup>4</sup> which may cause stickiness of the eyelids in the morning. Viral conjunctivitis is traditionally thought to be more likely if there is watery discharge, conjunctival follicles, and preauricular adenopathy. Allergic conjunctivitis is suggested by a stringy mucoid discharge and itchiness of the eyes.

## I. NORMAL CONJUNCTIVAL ANATOMY

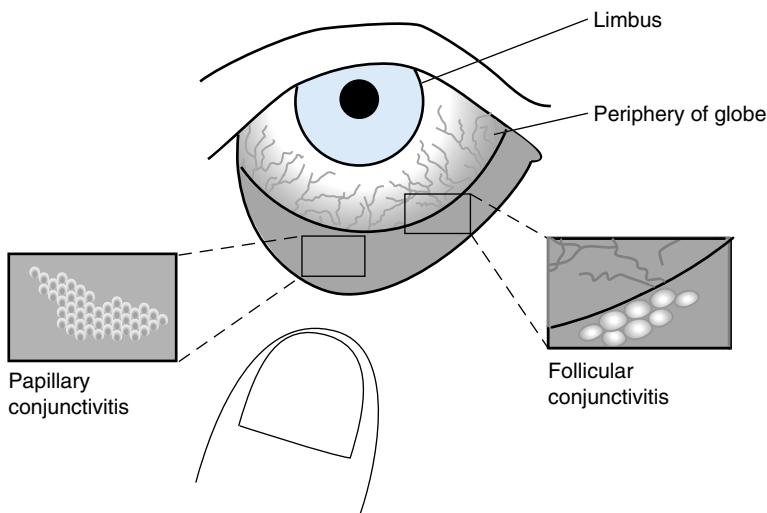
The normal anatomy of the conjunctiva appears in [Fig. 23.1](#).

## 2. PAPILLARY CONJUNCTIVITIS VERSUS FOLLICULAR CONJUNCTIVITIS

In conjunctivitis, combinations of hyperemia (vasodilation), edema, and hemorrhage produce a red color, which is most prominent on the undersurface of the lids and the more peripheral portions of the globe ([Fig. 23.2](#)). Some patients develop small projections on the conjunctival surface of the upper and lower lids (the *palpebral* or *tarsal* conjunctiva). These elevations are classified as *papillae* or *follicles* (i.e., papillary conjunctivitis or follicular conjunctivitis; see [Fig. 23.2](#)).



**FIG. 23.1 NORMAL CONJUNCTIVAL ANATOMY.** The figure compares the frontal view of the normal eye (left) with its corresponding sagittal section (right). The normal conjunctiva (colored blue, right) is a continuous translucent membrane that lines the undersurface of both eyelids (tarsal or palpebral conjunctiva), reflects backward (at the fornix), and then covers the anterior globe (bulbar conjunctiva). The conjunctiva ends at the limbus, the peripheral border of the cornea where it joins the sclera.



**FIG. 23.2 CONJUNCTIVITIS: PAPILLARY VERSUS FOLLICULAR.** The erythema of conjunctivitis (shaded dark gray) is most intense on the inside surface of the eyelids (tarsal conjunctiva) and peripherally on the globe (near the fornices), whereas the erythema is less intense centrally near the limbus. In more severe conjunctivitis the entire conjunctival surface (both tarsal and bulbar) is red. This pattern of erythema contrasts with iritis, which causes more intense erythema centrally around the limbus, a finding called *circumlimbal flush* or *ciliary flush*. In patients with conjunctivitis the clinician should inspect the everted upper or lower lids, noting whether the inner membrane has its normal smooth surface or instead has small uneven projections, which are characterized as either *papillae* or *follicles*. In this example the clinician has used his thumb to gently evert the lower lid for inspection. Papillae (left bottom) are contiguous red vascular bumps; the center of each papilla contains a blood vessel. They are red on the surface and pale at the base. Papillae are often so tiny that the conjunctiva acquires a velvety appearance and only magnification reveals their true nature. Other times, papillae may become large and produce a cobblestone appearance. Follicles (right bottom) are discrete 1- to 2-mm diameter white bumps consisting of aggregates of lymphoid tissue; the center of each is avascular. They are pale on the surface and red at the base. See the text for the significance of these findings.

Papillae characteristically appear in bacterial or allergic conjunctivitis. Follicles suggest viral or chlamydial conjunctivitis and are often associated with preauricular adenopathy.

### 3. RIETVELD SCORING SCHEME FOR BACTERIAL CONJUNCTIVITIS<sup>5</sup>

A diagnostic score for diagnosing bacterial conjunctivitis was developed by Rietveld and others, based on four independent predictors of positive bacterial cultures. These predictors are: (1) two “glued” eyes in the morning (+5 points); (2) one “glued” eye in the morning (+2 points); (3) itching (−1 points); and (4) history of conjunctivitis (−2 points). The clinician tallies the patient’s total score, which may range from −3 to +5).

## III. CLINICAL SIGNIFICANCE

### A. DISTINGUISHING SERIOUS FROM BENIGN DISEASE

In five studies of 957 consecutive patients with red eye, all three pupillary constriction tests increased probability of serious disease: indirect photophobia test (likelihood ratio [LR] = 28.8; [EBM Box 23.1](#)), finger-to-nose convergence test (LR = 21.4), and direct photophobia test (LR = 8.3). The presence of anisocoria (with the smaller pupil in the affected red eye and the difference in pupil size more than 1 mm) also increases probability of serious disease (LR = 6.5). The *absence* of pain in the affected eye during the finger-to-nose convergence test *decreases* probability of serious disease (LR = 0.3). In these studies, most patients with serious disease had anterior uveitis (iritis) or corneal disorders (herpes simplex infection, corneal abrasion, and miscellaneous causes of keratitis).

In general, the sensitivity of these classic findings is poor: 23% to 56% of patients with serious pathology lack photophobia and 81% lack anisocoria. In addition, even though abnormal visual acuity is a clue to serious eye disease, up to half of patients with proven iritis have a visual acuity of 20/60 or better.<sup>11</sup> The clinician should never use the finding of *normal* visual acuity as an argument *against* serious eye disease.

### B. DISTINGUISHING BACTERIAL CONJUNCTIVITIS FROM NONBACTERIAL CAUSES

#### I. INDIVIDUAL FINDINGS

In the three studies enrolling 281 consecutive patients with conjunctivitis summarized in [EBM Box 23.2](#), most excluded patients with previous eye trauma, eye surgery, chemical injury, visual blurring, contact lenses, conspicuous iritis (circumlimbal flush), or obvious deep orbital pathology. In these studies the most helpful items from the patient interview are matting of the eyes:<sup>4</sup> matting of both eyes in the morning increased probability of bacterial conjunctivitis (LR = 3.6), and absence of matting in both eyes decreased it (LR = 0.3).

Two physical findings increased probability of bacterial conjunctivitis: complete redness of the conjunctiva obscuring the tarsal vessels (LR = 4.6; see [EBM Box 23.2](#)) and observed purulent discharge (LR = 3.9). Absence of red eye when observed at 20 feet decreased probability of a bacterial cause (LR = 0.2). The symptoms of itching or burning and the findings of preauricular adenopathy, conjunctival follicles, or conjunctival papillae are diagnostically unhelpful (LRs not significant).<sup>4</sup> Finally,

**EBM BOX 23.1***The Red Eye, Diagnosing Serious Eye Disease\**

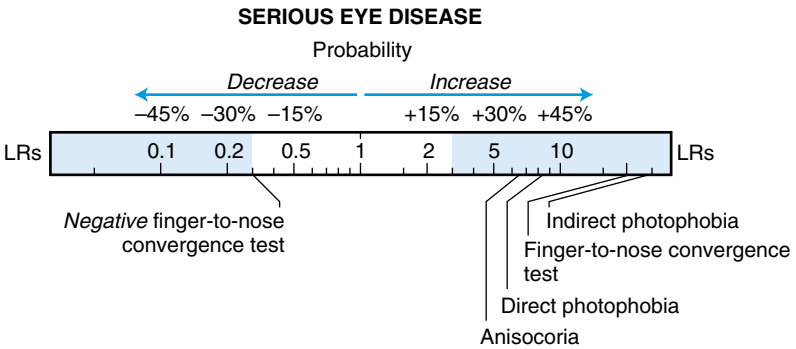
| Finding<br>(Reference) <sup>†</sup>   | Sensitivity<br>(%) | Specificity<br>(%) | Likelihood Ratio*<br>if Finding Is |        |
|---|--------------------|--------------------|------------------------------------|--------|
|   |                    |                    | Present                            | Absent |
| Direct photophobia <sup>6-8</sup>   | 54-77              | 80-98              | 8.3                                | 0.4    |
| Indirect photophobia <sup>6</sup>   | 44                 | 98                 | 28.8                               | 0.6    |
| Finger-to-nose convergence test <sup>9</sup>                                  | 74                 | 97                 | 21.4                               | 0.3    |
| Anisocoria, red eye<br>with smaller pupil<br>(difference >1 mm) <sup>10</sup> | 19                 | 97                 | 6.5                                | 0.8    |

\*Diagnostic standard: for *serious eye disease*, slit-lamp biomicroscopy revealing iritis, keratitis, corneal abrasion, scleritis, or acute narrow angle glaucoma.

<sup>†</sup>Definition of findings: for *pupillary constriction tests* (direct photophobia, indirect photophobia, finger-to-nose convergence test); see the text.

‡Likelihood ratio (LR) if finding present = positive LR; LR if finding absent = negative LR.

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even though the physical sign of purulent secretions is accurate, the patient's report of "purulent" secretions is diagnostically unhelpful (LR not significant).

## 2. COMBINED FINDINGS

The Rietveld score is accurate: a score of +4 or more increases probability of bacterial conjunctivitis (LR = 6.6) and a score of 0 or less decreases probability (LR = 0.4).

Another study of 700 patients<sup>14</sup> demonstrated that eye specialists using combinations of bedside findings could accurately diagnose the cause of conjunctivitis. The diagnostic standard in this study was cytology and cultures of conjunctival secretions: bacterial conjunctivitis was defined by positive bacterial culture and neutrophils; viral conjunctivitis by positive viral inclusions, mononuclear cells, and negative bacterial cultures; and allergic conjunctivitis by conjunctival eosinophils. The clinicians based the diagnosis of bacterial conjunctivitis on the findings of mucopurulent drainage and the absence of follicles and adenopathy, findings that turned out to be accurate for a



**EBM BOX 23.2**

*Conjunctivitis, Diagnosing Bacterial Etiology\**

| Finding<br>(Reference) <sup>*</sup>                      | Sensitivity<br>(%) | Specificity<br>(%) | Likelihood Ratio <sup>‡</sup><br>if Finding Is |        |
|--|--------------------|--------------------|--|--------|
|  |                    |                    | Present  | Absent |
| <b>Individual Findings</b>                               |                    |                    |  |        |
| Redness of conjunctiva                                   |                    |                    |  |        |
| Peripheral only <sup>5</sup>                             | 28                 | 58                 | NS   | NS     |
| Red eye observed at 20 feet <sup>12</sup>                | 94                 | 36                 | 1.5  | 0.2    |
| Redness completely obscures tarsal vessels <sup>12</sup> | 33                 | 93                 | 4.6  | NS     |
| Discharge <sup>12,13</sup>                               |                    |                    |  |        |
| None   | 12-28              | 41-56              | 0.4  | —      |
| Watery   | 6-12               | —                  | NS   | —      |
| Mucous   | 6-44               | —                  | NS   | —      |
| Purulent   | 32-50              | 85-94              | 3.9  | —      |
| Follicular conjunctivitis <sup>13</sup>                  | 50                 | 48                 | NS   | NS     |
| Papillary conjunctivitis <sup>13</sup>                   | 24                 | 95                 | NS   | NS     |
| Preauricular adenopathy <sup>12,13</sup>                 | 6-16               | 70-88              | NS   | NS     |
| <b>Combined Findings</b>                                 |                    |                    |  |        |
| Rietveld score <sup>5</sup>                              |                    |                    |  |        |
| +4 or more   | 39                 | 94                 | 6.6  | —      |
| +1 to +3   | 46                 | —                  | NS   | —      |
| -3 to 0  | 16                 | 62                 | 0.4  | —      |

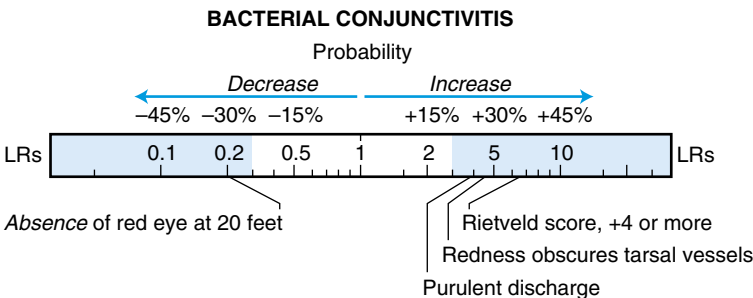
\*Diagnostic standard: for bacterial conjunctivitis, recovery of a known pathogen from conjunctival secretions (i.e., *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, or *Staphylococcus aureus*).

<sup>†</sup>Definition of findings: for follicular and papillary conjunctivitis, see Fig. 23.2; for Rietveld score, see the text.

<sup>‡</sup>Likelihood ratio (LR) if finding present = positive LR; LR if finding absent = negative LR.

NS, Not significant.

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bacterial cause (positive LR = 5.3; negative LR = 0.2). Combinations of scanty watery discharge, follicles, and preauricular adenopathy accurately diagnosed a viral cause (positive LR = 3.5; negative LR = 0.4). Finally, combinations of *allergic chemosis* (a pale swollen conjunctiva with a jelly-like appearance) and stringy mucoid discharge indicated an allergic cause (positive LR = 16.4, negative LR = 0.01). Still, it is unclear from the study how these experienced clinicians specifically combined each of these findings to achieve such spectacular accuracy.

*The references for this chapter can be found on [www.expertconsult.com](http://www.expertconsult.com).*

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